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Identification of Ecologically and Biologically Significant Areas on the West Coast of Vancouver Island and the Strait of Georgia, and in some nearshore areas on the North Coast: Phase II – Designation of EBSAs

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

This report presents the second phase of Ecologically and Biologically Significant Area (EBSA) identification for the remaining two Pacific continental shelf ecoregions, i.e., the West Coast of Vancouver Island (WCVI) and the Strait of Georgia (SoG), and adds to the EBSAs previously proposed for the Pacific North Coast. Some inshore additions to the earlier proposed Pacific North Coast Integrated Management Area (PNCIMA) are also presented. In Phase I, experts identified areas worthy of enhanced protection for each species and habitat feature based on five EBSA dimensions: Uniqueness, Aggregation, Fitness Consequences, Naturalness and Resilience. These areas were called Important Areas (IAs). In Phase II three categories of unique physical features were used as the basis for determining EBSAs. Physical features are useful in these types of area identification exercises because they often form the basis of the ecological communities and provide recognizable physical boundaries for management. The physical features chosen for the WCVI include oceanographic features and bottleneck areas, but because of scale issues, these features were not generally as useful in the SoG. In this latter area, some oceanographic features, only portions of others and sponge bioherms were used in EBSA determination. For the WCVI and SoG, seven and eight respectively of these features were identified and mapped and are presented as EBSAs. The overlap of these features with the remaining IAs was analyzed; the one excluded was "River Mouths and Estuaries". The WCVI EBSAs had a total area of approximately 18,215 km^2, i.e., 65% of the WCVI, while the SoG EBSAs cover approximately 2,488 km^2, i.e., 28% of the SoG. Individual EBSAs were profiled and their rationalization using EBSA criteria was provided. The additional PNCIMA EBSAs proposed are in the archipelago-fjord complex that characterizes the mainland coast of British Columbia.

Désignation des zones d’importance écologique et biologique sur la côte Ouest de l’île de Vancouver et dans le détroit de Géorgie, et dans certaines zones littorales de la côte Nord : Phase II – Désignation des ZIEB

RÉSUMÉ

Le présent rapport présente la deuxième phase du processus de désignation des zones d'importance écologique et biologique (ZIEB) pour les deux écorégions restantes du plateau continental du Pacifique, soit la côte Ouest de l'île de Vancouver et le détroit de Géorgie, lesquelles s'ajoutent aux ZIEB déjà proposées pour la côte Nord du Pacifique. Quelques zones côtières s'ajoutent également à celles proposées pour la zone de gestion intégrée de la côte nord du Pacifique (ZGICNP). Au cours de la phase I, les experts ont déterminé des zones méritant d'être mieux protégées relativement à chacune des espèces et des caractéristiques de l'habitat au moyen des cinq aspects des ZIEB : unicité, concentration, conséquences sur la valeur adaptative, caractère naturel et résilience. Ces zones ont été désignées comme des zones importantes. Au cours de la phase II, trois catégories de caractéristiques physiques uniques ont servi de fondement à la désignation de ZIEB. Les caractéristiques physiques sont utiles dans ce type d'exercices de désignation de zones parce qu'elles forment souvent la base des communautés écologiques et procurent des limites physiques faciles à reconnaître pour la gestion. Les caractéristiques physiques choisies pour la côte Ouest de l'île de Vancouver comprennent des caractéristiques océanographiques et des zones d'étranglement, mais en raison de problèmes d'échelle, ces caractéristiques ne sont pas avérées aussi utiles dans le détroit de Géorgie. Dans cette région, on a plutôt eu recours à certaines caractéristiques océanographiques, à une partie seulement des autres caractéristiques et à des biohermes à spongiaires pour la désignation des ZIEB. Pour la côte Ouest de l'île de Vancouver et le détroit de Géorgie, sept et huit de ces caractéristiques ont respectivement été déterminées et cartographiées, puis présentées comme étant des ZIEB. Le chevauchement de ces caractéristiques avec les zones d'importance restantes a fait l'objet d'une analyse; seuls les « embouchures et estuaires » ont été exclus. Les ZIEB de la côte Ouest de l'île de Vancouver couvraient une superficie totale d'environ 18 215 km², soit 65 % de cette région, alors que les ZIEB du détroit de Géorgie couvraient environ 2 488 km², soit 28 % de ce dernier. Un profil individuel a été établi pour chacune des ZIEB et justifié au moyen des critères de désignation de ZIEB. Les autres ZIEB proposées pour la ZGICNP sont situées au complexe de l'archipel et du fjord qui caractérise la côte de la partie continentale de la Colombie-Britannique.

1. INTRODUCTION

Ecologically and Biologically Significant Areas (EBSAs) have been identified as areas worthy of enhanced management or risk aversion (DFO 2004). An area can be identified as an EBSA if it ranks highly on one or more of three dimensions, Uniqueness, Aggregation and Fitness Consequences, with potential weighting by two other dimensions, Naturalness and Resilience (DFO 2004). In Phase I of the process to establish EBSAs in the Pacific North Coast Integrated Management Area (PNCIMA), the West Coast of Vancouver Island (WCVI) and the Strait of Georgia (SoG) (Clarke and Jamieson 2006a, Levesque and Jamieson 2011), regional scientific experts were engaged to identify Important Areas (IAs) that met at least one of the three primary EBSA criteria using a modified Delphic process. Thematic layers were produced that included species and/or guilds of fish, invertebrates, marine mammals, and reptiles, oceanographic features, provincial eco-units and Parks Canada areas of interest.

Phase II in the EBSA identification process for PNCIMA was presented by Clarke and Jamieson (2006b), and for the WCVI and in the SoG is presented here. Phase II uses physical and oceanographic features in each of Canada's three Pacific continental shelf ecoregions (Powles et al. 2004) as the basis for most EBSA identifications. The EBSA identification process in PNCIMA was initially done in its more offshore regions (Clarke and Jamieson 2006b), as there were at the time no national guidelines on how to address the much smaller geographical scale characteristics of nearshore areas which were identified as significant at a LOMA-scale. A more recent national workshop (DFO 2007) has provided guidance, however, and so relevant nearshore EBSAs are included here for all three coastal ecoregions. The 2007 national workshop recognized that if there were significant gaps in protection of coastal ecosystem structure and function, then the LOMA process should try to add specific sites (e.g., specific estuaries) as EBSAs to the list of conservation priorities. If it is not possible to identify site-specific EBSAs, the fallback is to list generic habitat type descriptions (e.g. the salinity gradient or the macroalgae beds in all estuaries), with the rationale that functional properties of the whole LOMA depend on processes that occur in these sites or habitats.

Some inshore additions to the earlier PNCIMA EBSAs indicated by Clarke and Jamieson (2006b) are thus also presented. As discussed by Clarke and Jamieson (2006b) for PNCIMA, virtually every location in an ecoregion can be identified as part of an IA for at least one species, and this also applies to the WCVI and SoG. They concluded that major oceanographic features as well as bathymetric and topographic constraining of species distributions to specific areas (i.e., bottleneck areas) could provide a basis for the identification of many EBSAs. Areas of high ocean productivity typically had overlapping aggregations of many species IAs that were utilising this productivity, giving these areas particular regional ecological significance. Similarly, bottleneck areas, in contrast to situations where habitat fidelity does not occur within a larger suitable habitat, are areas of high ecological significance as they can result in species' aggregations. The remaining identified EBSAs were for areas identified as Unique. This approach was thus used again for the WCVI and SoG, for both consistency and because it seemed to be the best approach given the data available.

While physiographic and oceanographic features for PNCIMA in Phase I captured at least a portion of the majority of IAs for the PNCIMA, WCVI and SoG, the EBSA identification process in the SoG also involved some other considerations. Because the SoG is relatively small in area in comparison to the other ecoregions and shows much more water column stratification, a slightly different approach was justified to use oceanographic features to help determine EBSA boundaries in that ecoregion (explained further below).

In all three regions, we compared biological congruence with physiographic features where possible by analyzing the occurrence and overlap of IAs . From this process, we developed and provide a list of EBSAs in PNCIMA, off the WCVI and in the SoG. The ecological and biological significance of each area is explained in their profiles below.

2. EBSA IDENTIFICATION CRITERIA

As discussed by Clarke and Jamieson (2006b), unique physiographic features may be considered ecologically important because in many cases, they provide the physical basis and serve as relatively easily measurable proxies for biological ecosystem attributes. These physical features describe the specific physical environmental conditions that rationalise ecologically significant communities. An additional advantage of largely identifying EBSAs based on physical features of the marine environment is greater ease in suggesting rough EBSA boundaries. In many cases, these physical features have clearer mapped boundaries than do the biological IAs, and so can be useful in planning and management process.

There are three categories of physical features that we have recognised as significant for the PNCIMA, WCVI and SoG regions:

1) Physical oceanographic features such as eddies and current systems are mechanisms by which marine productivity is concentrated or are the means by which greater recruitment can be achieved (W. Crawford and D. Mackas, DFO, Sidney, pers. comm.). The presence of these features is often fundamental to the population dynamics and spatial structure of an associated higher trophic level biological community (e.g., Crawford and Jamieson 1996). During Phase I, experts identified four oceanographic IAs on the WCVI and three in the SoG for their unique characteristics (Uniqueness), both regionally and nationally, and for their characteristics that concentrate productivity (Aggregation).

2) Bottleneck areas are places where congestion (Aggregation) occurs by virtue of the surrounding physical geography. Migrating species are concentrated in these areas and unique communities are created by their seasonal presence and the ecosystems associated with them. For migrating species, the absence of alternate migration routes means that access to these areas is often essential to the fitness of these populations (Fitness Consequences). The primary Large Ocean Management Area (LOMA)-scale bottleneck area identified on the WCVI (Uniqueness) is Juan de Fuca Strait, and in the SoG, the entrance to Discovery Passage which leads into the relatively narrow gap between Vancouver Island and the BC mainland coast, consisting of Johnstone and Queen Charlotte Straits (the latter are identified PNCIMA EBSAs (Clarke and Jamieson, 2006b)). As in PNCIMA, estuaries and the immediate waters off the mouths of the rivers should also be considered as bottleneck areas for anadromous species, as these species congregate there before moving either to sea as smoults (in the case of salmon) or upstream as adults. There are many estuarine bottlenecks in the PNCIMA, SoG and on the WCVI and all of these areas should be treated as EBSAs, though no attempt has been made to define most of them spatially here because of their relatively small sizes at a LOMA-scale. However, two relatively large scale bottlenecks identified include Alberni Inlet and Barkley Sound for Pacific salmon on the WCVI and the Fraser River Estuary in the SoG for Pacific salmon and eulachon. Anadromous species typically have large geographic ranges and therefore need to be managed at a LOMA scale rather than at a smaller Coastal Management Area (CMA) scale, and so bottlenecks that influence them, even if relatively small, are flagged here.

3) The PNCIMA and the SoG are home to some globally unique biogenic habitats, the hexactinellid sponge bioherms. They are believed to be the only extensive communities of their kind in the world (Uniqueness), are long-lived and are extremely sensitive to physical disturbance because of their fragile body structure and sedentary nature (Resilience).

3. ANALYSIS

A comparison of the oceanographic and bottleneck layers from Phase I and the remaining thematic IAs was performed for the WCVI and SoG, similar to that described for PNCIMA (Clarke and Jamieson (2006b), with results in Table 14. In addition, River Mouths and Estuaries were designated as EBSAs, as was done for PNCIMA.

In determining the percentages of each IA included in the individual EBSAs, the following criteria were implemented:

- Percentages are rounded to the nearest whole percentage and represent the amount of the IA that is captured by that particular EBSA.
- Any overlaps less than 1% were not included in tables.
- Boundaries of a feature are to some extent arbitrary, both because in reality they do not have rigid boundaries and because they were hand drawn by experts on a map.

These percentages are thus simply meant to give a general idea of how much of an IA is captured by an EBSA and are not precise measures.

3.1. WEST COAST OF VANCOUVER ISLAND ECOREGION

Overall, 127 out of 156 (81.4%) IAs identified for the WCVI (Levesque and Jamieson 2011) are captured by the six WCVI oceanographic and bottleneck IAs (Fig. 2). 74.5% of the geographic area of biological IAs overlaps with that of oceanographic and bottleneck features. The six oceanographic and bottleneck IAs cover approximately 18,215 km², i.e., 65% of the WCVI (total area = 28,153 km²). Biological IAs that were not significantly captured (less than 20%) on the WCVI include those of the sea otter, sixgill shark, and geoduck.

Analyses were conducted to indicate the extent that biological IAs overlapped in each EBSA (Fig. 3). Thematic IAs that overlapped each of the identified EBSAs are listed and the specific details of the biological importance of each EBSA to each relevant species is described in the profiles below and in Table 15. EBSAs with the highest number of IAs layers that at least partially overlapped them were the Shelf Break (33), Brooks Peninsula Jets (29), Juan de Fuca Eddy (29), and the Edges of the Banks and Basin off of Barkley Sound (27).

3.2. STRAIT OF GEORGIA ECOREGION

The SoG ecoregion is the smallest ecoregion in Canadian marine waters, and is much smaller than either PNCIMA and the WCVI (PNCIMA: 102,067 km², WCVI: 28,104 km², SoG: 8801 km²; to provide a national perspective, PNCIMA in turn is about a quarter the size of both the Gulf of St. Lawrence and Eastern Scotian Shelf Integrated Management Areas). In the identification of IAs (Phase I), some of the oceanographic features identified for PNCIMA are large enough to comprise most of the SoG, and this made it difficult to identify oceanographic features of the same ecoregion scale for all Pacific ecoregions. An EBSA, being an area of enhanced management of human activities, cannot encompass most of an ecoregion, as the whole ecoregion would then largely be managed the same way. Enhanced management would then

be difficult to achieve, as all human activities in all marine waters are already managed, at least in theory.

Oceanographic features identified by experts in the SoG (Fig. 4) include vertically mixed waters via tidal currents, thermally and salinity driven stratified waters, the Fraser River plume, and biological fronts. Reasons for identification based on the EBSA criteria are discussed in oceanographic section of the Phase 1 report (Levesque and Jamieson 2011).

Parks Canada classified oceanographic regions with relatively distinctive oceanographic processes for their representivity report of the proposed southern Strait of Georgia NMCA (Robinson and Royle 2008). We performed a similar classification process for the SoG based on the features identified by the experts during the Delphic phase and looked at all the identified oceanographic features together. Locations of stratified waters were classified and the Fraser River plume was wrapped up into the portion of the Strait that is stratified by salinity.

Considerations in determining suggested SoG EBSAs were:

- Comparison of oceanographic features to identify where overlaps occurred between them and other physical features (bottlenecks, estuaries and river mouths, and sponge reefs).
- Recognition that the "stratified waters" feature is too large to be an EBSA on its own.
- Recognition that fronts, i.e., boundaries between mixed and stratified waters, were too small to be EBSAs,
- Selection of a single stratified area – Desolation Sound – to capture this feature as an EBSA, as it includes both stratified waters and nearshore hard substrates, which are less common on the west side of the Strait except in the Gulf Islands. Different benthic communities occur on rocky versus soft substrates in stratified waters. Selection of this was more subjective than was identification of other suggested SoG EBSAs.
- Boundary Bay was included as part of the Fraser River estuary EBSA, as it has an extensive intertidal area (physical feature) that is important for many bird species and is functionally part of the Fraser River delta.

Overall 74 out of 101 (73.3%) IAs identified for the SoG are captured by the oceanographic and bottleneck IAs. The seven EBSAs identified in the SoG (Fig. 5) cover approximately 2, 488 km^2, i.e., 28% of the SoG. 39.7% of the geographic area that IAs occupy overlaps with the region's oceanographic and bottleneck features.

IA spatial layers that were not significantly captured (less than 20%) in the SoG include those for hake, brown cat shark, and euphausiids.

3.3. PACIFIC NORTH COAST ECOREGION

As with EBSAs proposed off river mouths and estuaries, some ecologically significant nearshore PNCIMA areas were too narrow to be accurately mapped at an ecoregion or LOMA scale. However, because such areas can be associated with specific geographical areas, they are mapped (Fig. 7), although their distances shown from shore in Fig. 7 are not necessarily to scale. In 2006 when the other PNCIMA EBSAs were proposed, there were no national guidelines as to how to consider significant nearshore areas, but a national workshop (DFO 2007) clarified criteria, which have been applied here.

4. PROFILES OF PROPOSED WCVI EBSAS

WCVI oceanographic features (Fig. 1) were used as the basis for determining WCVI EBSAs. The overlap of IAs in these EBSAs is shown in Fig. 3.

4.1. BROOKS PENINSULA

Biophysical Description (Fig. 2): Jets form off Brooks Peninsula and are areas of high productivity and plankton concentration (D. Mackas; B. Crawford, DFO, Sidney, pers. comm.). There is also a high nutrient content that is transported seaward in these jets (D. Mackas; B. Crawford, DFO, Sidney, pers. comm.). They separate from the continental shelf around Cape Cook on Brooks Peninsula (B. Crawford, DFO, Sidney, pers. comm.). An area was outlined from Cape Cook, extending in a southern direction based on satellite images of water temperature from Mackas and Yelland (1999) to a 55 km buffer around the peninsula (D. Mackas, DFO, Sidney, pers. comm.). Contiguous to the PNCIMA Brooks Peninsula proposed EBSA (#5) (Jamieson and Clarke 2006, see below).

Biological Significance: Which EBSA criteria are captured by each EBSA could not be easily determined, as there were some difficulties in ranking each IA by each EBSA criteria. Nevertheless, Table 1 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 1. Biological Significance of the Brooks Peninsula EBS

<table>
<tr><th>Species Group</th><th colspan="2">Species IAs Overlapping in EBSA</th><th>Why IA important under EBSA criteria</th><th>Proportion of IA(s) captured in EBSA (%)</th></tr>
<tr><td>Marine Birds</td><td colspan="2">Bird colony on Solander Island</td><td>Surrounding foraging area</td><td>89</td></tr>
<tr><td rowspan="3">Cetaceans</td><td colspan="2">Blue, Sperm, Sei and Fin Whales</td><td>Where most sightings have been observed</td><td>11</td></tr>
<tr><td rowspan="2">Gray Whale</td><td>Migratory population</td><td>Migratory corridor</td><td>21</td></tr>
<tr><td>Summer resident population</td><td>Foraging areas</td><td>16</td></tr>
<tr><td rowspan="2">Pinnipeds</td><td colspan="2">Harbour seal</td><td>Surrounding foraging area of four haul out sites (out of 27 on the WCVI)</td><td>80 (of the total foraging area of all four haul out sites)</td></tr>
<tr><td colspan="2">Steller Sea Lion</td><td>Surrounding foraging area from three haul out sites (two sites at Barrier Islands and one on Solander Island) out of a total of 11 for the WCVI</td><td>92 (of the total foraging area of all three haul out sites)</td></tr>
<tr><td>Sea Otter</td><td colspan="2">Sea otter</td><td>Current range</td><td>16</td></tr>
<tr><td rowspan="2">Anadromous Fish</td><td colspan="2">Juvenile Pacific Salmon</td><td>Migration and Foraging area</td><td>11</td></tr>
<tr><td colspan="2">Green Sturgeon</td><td>Migration route</td><td>15</td></tr>
</table>

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Pelagic Fish	Herring	Third highest ranked cumulative spawning and rearing area	15
		Juvenile rearing and spawning sites	19
		Feeding area (pre-recruit and adult herring)	20
	Sardine	Foraging and migration	11
Elasmobranchs	Alaska Skate	Distribution	22
	Big Skate	Distribution	13
	Brown Cat Shark	Distribution	17
	Deepsea Skate	Distribution	14
	Longnose Skate	Distribution	12
	Pacific Sleeper Shark	Distribution	21
	Roughtail Skate	Distribution	14
	Sandpaper Skate	Distribution	23
Flatfish	Halibut	One of two IA distributions	72 of that one IA
	Petrale Sole	One of four winter (spawning season Dec-Mar) and summer distributions	17
	Rex Sole	Distribution	7
Roundfish	Pacific Hake	Northern part of migratory corridor	10
Coral and Sponge	Corals and Sponges	IA of high bycatch:	
		Crowther Canyon	91
		Esperanza Canyon	25
Invertebrates	Tanner Crab (*Chionoecetes tanneri*, *C. angulatus*)	Part of a narrow distribution along continental shelf	10
	Shrimp (smooth pink)	Aggregation area	3
Turtle	Leatherback	Foraging area (Note: sightings are infrequent and widespread and its thus difficult to draw conclusion about specific areas of significance)	12

4.2. SHELF BREAK

Biophysical Description (Fig. 2): The shelf break was identified as an important area for its high productivity (B. Crawford; M. Foreman; D. Mackas, DFO, Sidney, pers. comm.) and high aggregation of macrozooplankton (D. Mackas, DFO, Sidney, pers. comm.). The shelf break IA

extends approximately 20 km offshore of the 200 m shelf break isobath and inshore to approximately the 100 m depth contour (B. Crawford; M. Foreman; D. Mackas, DFO, Sidney, pers. comm.; I. Perry, DFO, Nanaimo, pers. comm.). In the continental slope there are submarine canyons, which are important areas for aggregations of zooplankton and trophic transfer (D. Mackas, DFO, Sidney, pers. comm.). Contiguous to the PNCIMA Brooks Peninsula proposed EBSA (#7; Clarke and Jamieson 2006b). Table 2 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 2. Biological Significance of the Shelf Break EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	Marine Birds	Foraging area of major bird colony on Solander Island	13
		Pelagic species foraging area	53
Cetaceans	Blue, Sei, Sperm, and Fin Whales	Where most sightings have been observed	48
	Humpback Whale	High concentration and consistently utilized important feeding area	46
		Area less often sighted	35
Pinnipeds	Fur Seal	Wintering area (Largest concentration of sightings in BC, 50% of WCVI sightings)	9
	Steller Sea Lion	Foraging area of haul out sites	
		Barrier Islands (two haul out sites here) and Solander Island	23
		Perez Rocks	10
Anadromous Fish	Juvenile Pacific Salmon	Migration and Foraging area	31
Pelagic Fish	Pacific Herring	Feeding area 1 (larger aggregations of pre-recruit and adult)	11
		Feeding area 2 (pre-recruit and adult herring)	45
	Eulachon	Older juvenile offshore feeding area	35
	Sardine	Migration and foraging area	39

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Elasmobranchs	Basking Shark	Area of historic abundance and recent sightings	18
	Brown Cat Shark	Portion of distribution where found	78
	Pacific Sleeper Shark	One of two IAs where found	100
	Alaska Skate	Portion of distribution where found	99
	Big Skate	The area where the majority of sandpaper are found on the WCVI plus a portion of the whole BC area where found	51
	Deepsea Skate	Portion of distribution where found	55
	Longnose Skate	The area where the majority of longnose are found plus a portion of the BC area where found	46
	Roughtail Skate	Portion of distribution where found	67
	Sandpaper Skate	The area where the majority of sandpaper are found on the WCVI plus a portion of the whole BC area where found	42
Roundfish	Pacific Hake	Migratory corridor	59
Flatfish	Arrowtooth Flounder	Distribution	86
	Deepsea Sole	Distribution	100
	Dover Sole	Winter (spawning season Dec-Mar)	98
		Summer	55
	English Sole	Four of five IAs overlap	42
	Halibut	Both IA overlap	52
	Petrale Sole	Winter (spawning season Dec-Mar) and Summer distributions	17
	Rex Sole	Distribution	74
Corals and Sponge	Corals and Sponge	Three bycatch IAs	93

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Invertebrates	Tanner crab (*Chionoecetes tannerii C. angulatas*)	Range	39
	Shrimp (smooth pink)	Aggregations	86
Turtle	Leatherback	Foraging area	41

4.3. CONTINENTAL SHELF OFF BARKLEY SOUND

Biophysical Description (Fig. 2): The edges of the banks and basins across from Barkley Sound include La Perouse, Swiftsure, Amphitrite and Finger Banks. These areas are productive, aggregate zooplankton and are areas of trophic transfer (D. Mackas, B. Crawford, DFO, Sidney, pers. comm. and I. Perry, DFO, Nanaimo, pers. comm.). Table 3 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 3. Biological Significance of the Continental Shelf off Barkley Sound EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	Pelagic species	Shelf break foraging area	41
Cetaceans	Southern Resident Killer Whale		36
	Humpback Whale	Feeding area, high concentration	58
	Gray Whales	Migration route	18
		Summer Resident Population	71
	Harbour Porpoise	High abundance from April to October	9
Pinnipeds	Harbour Seal	Foraging area for three haul out sites	79
	Northern Fur Seal	50% of WCVI sightings (foraging area)	99
	Steller Sea Lion	Foraging areas for five haul out sites (Wouwer Island, Long Beach Rocks, Pachena Point, Folder Island, and Carmanah Point)	68
Anadromous fish	Green Sturgeon		37

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Pelagic Fish	Eulachon	Migration Corridor	4
		Older juvenile offshore feeding area	45
		Young juvenile rearing areas	10
	Herring	Second highest ranked cumulative spawning and rearing area	3
		Migratory corridor	100
		Juvenile rearing (five km from shore) spawn sites within	29
	Pacific Sand Lance	Potential spawning and burrowing habitat (to 100 m depth)	42
		Confirmed habitat for Sand Lance	93
	Sardine	Feeding area, migration corridor	33
Elasmobranchs	Basking Shark	Historical area of concentration	37
	Big Skate	Distribution	27
	Longnose Skate	Distribution	30
	Pacific Sleeper Shark	Distribution	100
	Sandpaper Skate	Distribution	23
Flatfish	Halibut	Distribution	64
	Sanddab	Distribution	100
	Rex Sole	Distribution	24
	Rock Sole	Distribution	83
Roundfish	Hake	Separate stock from offshore migratory stock	7
		Aggregation	8
		La Perouse Bank - foraging and migratory Corridor between 80-500 m	36
	Pacific Cod	Spawning	95
Invertebrates	Dungeness Crab	High concentration	28

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
	Shrimp	*Pandalopsis dispar, Pandalus jordani*	100
		Pandalopsis dispar, Pandalus jordani	92
		Pandalus jordani	9
Turtle	Leatherback	Foraging	19

4.4. JUAN DE FUCA EDDY

Biophysical Description (Fig. 2): The Juan de Fuca Eddy is an area of retention and of high productivity (A. Pena, DFO, Sidney, pers. comm). It forms during the summer months at the southwest side of Vancouver Island near the mouth of the Juan de Fuca Strait. The eddy is dynamic and can collapse and reform. The spatial boundary for mapping this feature was determined by satellite images of water temperature and phytoplankton biomass. Table 4 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 4. Biological Significance of the Juan de Fuca Eddy EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	Pelagic species	Foraging Area	11
Cetaceans	Southern Resident Killer Whale	Swiftsure Bank	32
	Humpback Whale	Area of concentration; consistently utilized foraging area	16
	Harbour Porpoise	High sightings area in Juan de Fuca Strait	6
	Gray Whale	Migratory	3
		Resident	54
Pinnipeds	Harbour Seal	Foraging area around four haul outs	60
	Steller Sea Lion	Foraging area around two haul out sites	
		Carmanah Point	53
		Pachena Point	63
	Northern Fur Seal	High concentration	13
Anadromous Fish	Juvenile Pacific Salmon	Migration and Foraging area	8
	Green Sturgeon	Migration route	6
	Eulachon	Older juvenile offshore	13

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
		feeding area	
Pelagic Fish	Sardine	Migration and foraging area	9
	Pacific Sand Lance	Potential spawning and burrowing habitat (to 100 m)	40
		Confirmed habitat for Sand Lance	64
Elasmobranch	Basking Shark	Historical area of concentration	3
	Big Skate	Distribution	7
	Longnose Skate	Distribution	8
	Sandpaper Skate	Distribution	7
Roundfish	Hake	La Perouse Bank - foraging and Migratory Corridor, 80-500 m	13
		Aggregation	5
	Herring	Feeding area (Large aggregations of pre-recruit and adult)	39
Flatfish	Arrowtooth flounder	Distribution	4
	Dover sole	Summer IA and a smaller portion (~ 8 %) of the winter IA	40
	English sole	Distribution	100
	Flathead sole	Distribution	5
	Petrale sole	Summer IA and 18% of the winter IA	100
	Rex sole	Distribution	4
	Rock sole	Distribution	8
	Sand sole	Distribution	38
Invertebrates	Shrimp	*Pandalopsis dispar, Pandalus jordani*	23, 35
Turtle	Leatherback	Foraging	5

4.5. BARKLEY SOUND AND ALBERNI INLET

Biophysical Description (Fig. 2): Geographic bottleneck for salmonids going to Henderson, Sproat and Great Central Lakes on Vancouver Island. Table 5 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 5. Biological Significance of the Barkley Sound and Alberni Inlet EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	Surf Scoters	Wintering and in the spring feeding on the herring spawn.	99
	Pacific Loons and Ducks	Wintering and staging	
	Pelagic seabirds including Pigeon Guillemots, Marbled Murrelets	High numbers	
	Gull and Pelagic Cormorants	Nesting colonies	
Cetacean	Gray Whale	1 of 8 resident foraging areas	21
	Humpback Whale	Area of concentration; consistently utilized foraging area	6
Pinnipeds	Harbour Seal	Foraging area for six haul out sites out of a total	12-100
	Steller Sea Lion	Foraging area for three haul out sites (Wouwer Island, Pachena Point, and Folger Island)	19
Anadromous Fish	Juvenile Pacific Salmon	Migration and Foraging area	3
	Green Sturgeon	Migration route	6
Pelagic	Herring	Juvenile rearing and spawn sites	85
	Eulachon	Young juvenile rearing areas	38
	Sand Lance	Suitable habitat	100
	Sardine	Migration and foraging area	4
Elasmobranch	Basking Shark	Historical area of concentration	7
	Big Skate	Distribution	3
	Longnose Skate	Distribution	2
	Sandpaper Skate	Distribution	2
	Sixgilled Shark	Distribution	18
Flatfish	All species	Nearshore juvenile rearing	31
Roundfish	Hake	Inshore inlets stocks are separate from the offshore migratory stock	37

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Invertebrates	Bivalves	Olympia oyster	12
		Pacific Oyster	15
	Shrimp	Two *Pandalopsis dispar IAs*, one *Pandalus jordani* IA	100, 10

4.6. JUAN DE FUCA STRAIT

Biophysical Description (Fig. 2): Geographic bottleneck for salmonids, herring and other species moving between either the Strait of Georgia or rivers flowing into it and the outer continental shelf or open Pacific waters. Table 6 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 6. Biological Significance of the Juan de Fuca Strait EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Cetaceans	Southern Resident Killer Whale	Critical Habitat	69
	Resident Gray Whale	1 of 8 Foraging areas	15
	Harbour Porpoise	High abundance	81
Pinnipeds	Harbour Seal	Foraging area of 11 haul out sites	26
	Steller Sea Lion	Foraging area of 2 haul out sites	14
Anadromous fish	Juvenile Pacific Salmon	Migration and Foraging area	7
Pelagic fish	Herring	Migratory Corridor	100
		Unique spawning area (timing and genetics)	100
	Eulachon	Migratory corridor	100
Elasmobranch	Big Skate	Distribution	7
	Longnose	Distribution	8
	Sandpaper	Distribution	7
Flatfish	Dover	One of two summer areas	66
Roundfish	Hake	Aggregation	99
Invertebrates	Green Sea Urchin	High concentration	100
	Dungeness Crab	3 aggregations	100

5. PROFILES OF PROPOSED SOG EBSAS

SoG oceanographic features (Fig. 4) were mostly used as the basis for determining EBSAs (Fig. 5), but because of the relatively large sizes of some features, in some cases, such as with stratified waters, only a portion of the feature has been includedan as part of an EBSA. In most cases, this was when a smaller feature overlapped, and so the suggested EBSA was the

smaller feature, which had a portion of the larger feature. The overlap of IAs in these EBSAs is shown in Fig. 6.

5.1. DISCOVERY PASSAGE ENTRANCE

Biophysical description (Fig. 5): Geographic bottleneck, biological front, and vertically mixed waters via tidal currents. Extension of the North Island Straits EBSA (#9) identified for PNCIMA (Clarke and Jamieson 2006b). Table 7 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 7. Biological Significance of the Discovery Passage Entrance EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Pinnipeds	Harbour Seal	Foraging area around one haul out site	4
Pelagic Fish	Herring	Juvenile rearing spawning sites within area	4
	Sand Lance	Potential spawning and burrowing habitat	20
Invertebrates	Green Sea Urchin	High aggregations	3
	Scallops (Spiny and Pink)	High density area	23

5.2. DESOLATION SOUND AND PENDRELL SOUND

Biophysical description (Fig. 5): Thermally stratified waters and rocky substrate. Selected from other areas in the Strait that also have these two features because of its Aggregations of animals. Table 8 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 8. Biological Significance of the Desolation Sound and Pendrell Sound EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	Surf Scoters	3-4,000 wintering birds	59
	Marbled Murrelets	100s of breeding pairs in summer and individuals throughout year	
Anadromous fish	Juvenile salmon	Inlets have landward migrating adults and seaward migrating juveniles	11
Pelagic fish	Herring	Juvenile rearing and spawn sites	4
Groundfish	Hake	SoG stock - Summer foraging area	8

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Invertebrates	Pacific Oyster	Pendrell Sound: consistent breeding adults; good recruitment; area used for seed collection for grow out in other areas	14
	Scallops (purple-hinged rock scallop)	Known concentration	86

5.3. BAYNES SOUND

Biophysical description (Fig. 5): Thermally stratified waters and soft substrate (relatively large biomass of benthos in the soft substrate associated with thermally stratified waters) and biological fronts. Table 9 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 9. Biological Significance of the Baynes Sound EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Marine Birds	>10,000 birds including Brant and Harlequin Ducks	Staging (foraging on herring spawn in the spring)	14
Pinnipeds	Harbour Seal	Foraging area for a haul out site	1
	Steller Sea Lion	Foraging area around the only IA haul out site in the SOG	10
Pelagic Fish	Herring	Highest ranked cumulative spawning and rearing area	8
Invertebrates	Butter Clam	High density	100

5.4. SABINE CHANNEL

Biophysical description (Fig. 5): Thermally stratified waters and rocky substrate and biological fronts between Lasqueti and Texada Islands. Table 10 lists the importance of this EBSA for each species with an IA that is at least partially included within it. This in some years at least is also a bottleneck migratory channel for Fraser River sockeye returning to the Fraser River that came south through Johnstone Strait.

Table 10. Biological Significance of the Sabine Channel EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
Pinnipeds	Harbour Seal	Foraging area for a	1

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA(s) captured in EBSA (%)
		haul out site	
Elasmobranchs	Big Skate	Distribution	1
	Longnose Skate	Distribution	1

5.5. SOUTHERN GULF ISLANDS

Biophysical description (Fig. 5): Vertically mixed waters via tidal currents throughout most of the Gulf Islands with more stratified sections throughout the northwest Gulf Islands. Biological fronts inside some island passages including Porlier and Active Passages and at the mouth of Saanich Inlet. Includes seven of the glass sponge reef complexes. Table 11 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Table 11. Biological Significance of the Southern Gulf Islands EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA captured in EBSA (%)
Cetaceans	Southern Resident Killer Whales	Critical Habitat under SARA	37
	Harbour Porpoise	High abundance in summer months (also present year round)	21
Pinnipeds	Harbour Seal	Foraging area around ten haul out sites	24
Anadromous fish	Juvenile Pacific Salmon	Juvenile rearing area	86
Pelagic Fish	Herring	Juvenile rearing (5 km from shore) spawn sites	19
		Highest ranked cumulative spawning and rearing area	30
	Pacific Sand Lance	Potential spawning and burrowing habitat	80
	Eulachon	Larval rearing	38
Elasmobranchs	Alaska Skate	Distribution	74
	Big Skate	Distribution	14
	Longnose Skate	Distribution	14
	Sandpaper Skate	Distribution	71
Invertebrates	Green Sea Urchin	High aggregations (1 of 2 IAs)	75% (out of all the high aggregation areas identified)
	Dungeness Crab	2-3 Aggregations	43

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA captured in EBSA (%)
	Tanner Crab (*C. bairdi*)	2^{nd} highest concentration area on B.C. coast	85
	Scallops (pink and spiny)	High density	53 (of all the pink and spiny areas)
	Shrimp (*Pandalopsis dispar, Pandalus* Invertebrates *borealis, P.andalus danae*)	All three survey areas with these species present together	100
Sponges	SoG sponge reefs; #6 Nanaimo; #7-12 Active Pass (refer to Table 13)	Structural habitat forming species	100

5.6. FRASER RIVER ESTUARY AND BOUNDARY BAY

Biophysical description (Fig. 5): Fraser River Estuary: Salinity driven stratified water; biological front; bottleneck for anadromous species; includes one glass sponge reef complex; Boundary Bay has an extensive intertidal area.

Biological Significance (Fitness Consequence): Boundary Bay is an important marine bird wintering ground. Table 12 lists the importance of this EBSA for each species with an IA that is at least partially included within it.

Note: This is also the Fraser River – bottleneck estuarine EBSA, mapped due to its relatively large size (all other anadromous bearing river mouths are also EBSAs but because of their relatively small areas are not mapped.)

Table 12. Biological Significance of the Fraser River Estuary and Boundary Bay EBSA

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA (s) captured in EBSA (%)
Marine Birds	Trumpeter Swans (100's); Snow Geese (10,000s); Duck species (10,000s); Western Sandpipers (100,000s) ; and other species as well.	Largest estuary in B.C. and is a wintering ground for many marine bird species throughout the spring, fall and winter	70
Cetaceans	Southern Resident Killer Whales	Part of Critical Habitat	54
	Harbour Porpoise	High abundance	27
Pinnipeds	Harbour Seal	Foraging area around 5 haul out sites	15
Anadromous Species	Juvenile Pacific Salmon	Larval rearing and the Fraser River (largest	100

Species Group	Species IAs Overlapping in EBSA	Why IA important under EBSA criteria	Proportion of IA (s) captured in EBSA (%)
	Eulachon	spawning river in the South Coast region) mouth is a bottleneck that aggregates both landward returning adults that are staging before heading up the river to spawn and seaward migrating juveniles.	28
Pelagic Fish	Herring	Juvenile rearing and spawn sites	8
Elasmobranchs	Alaska Skate	Distribution	11
	Big Skate	Distribution	7
	Sandpaper Skate	Distribution	7
Roundfish	Walleye Pollock	Spawning area for SOG stock	37
Invertebrates	Dungeness Crab	Aggregation	27
	Shrimp (*Pandalopsis dispar, Pandalus jordani, P. borealis*)	Aggregations	27
Sponges	SoG glass sponges reef; (#1 sponge reef – Fraser Ridge) (refer to Table 13)	Structural habitat forming species	100

5.7. SPONGE REEFS

Biophysical description (Fig. 5): Sixteen glass sponge reef complexes have been found to date in the SoG. (Table 13).

Table 13. Locations of glass sponge reef complexes in the Strait of Georgia ecoregion.

Number (in chronological order of discovery)	Location	Reference
1	Fraser Ridge (in Fraser River Estuary and Boundary bay EBSA)	(Conway *et al.* 2005)
2-4	McCall Bank	(Conway *et al.*, 2007)
5	Parksville	(Conway *et al.*, 2007)
6	Nanaimo (in Gulf Islands EBSA)	(Conway *et al.*, 2007)
7-12	Active Pass (in Gulf Islands EBSA)	(Conway *et al.*, 2007)
13	"Coulee Bank"	(Conway *et al.*, 2007; Cook *et al.*, 2008)
14	Howe Sound (Passage Island)	(Cook *et al.*, 2008);

Number (in chronological order of discovery)	Location	Reference
15	Sound (Defence Islands)	(Marliave *et al.*, 2009);
16	Ajax Bank	(K. Conway, Natural Resources Canada, unpublished data).

6. RIVER MOUTHS AND ESTUARIES OFF THE WCVI AND IN THE SOG

Biophysical description: Waters off river mouths and associated estuaries in the SoG and WCVI (includes rivers that support anadromous species as well as all others). These areas are not shown on the maps here because of their relatively small size at a LOMA scale. These EBSAs are not mapped because of their relatively small scale on the maps shown.

Biological Significance:

1) The constricting geographic characteristics of river mouths and estuaries cause bottleneck aggregations of landward returning adult anadromous species that are staging and heading up their natal rivers to spawn and seaward migrating juveniles that are acclimating to saltwater.
2) Salmon utilize spawning rivers and estuaries in both the WCVI and SoG ecoregions. Each river mouth and estuary along the mainland and Vancouver Island coast is important habitat for salmon. These areas are also consistently used seasonally and annually and thus are always important (K. Hyatt, DFO, Nanaimo, pers. comm.). Salmon smolts utilize estuaries and immediate waters around river mouths to adjust to a changed osmotic balance when moving from freshwater to saltwater. Adult salmon congregate off river mouths in the summer and fall while they wait for river levels to rise or waters temperatures to fall sufficiently so they can move upstream to spawn.
3) Eulachon use three spawning rivers along the mainland coast of the SoG ecoregion between March and May (Hay and McCarter, 2000). The largest spawning run in the South Coast region occurs in the Fraser River; with significantly smaller runs occurring in the Squamish River at the northern end of Howe Sound and the Homathko River at the northern head of Bute Inlet (Hay and McCarter, 2000).

7. MODIFIED AND ADDITIONAL PROFILES OF PROPOSED NEARSHORE PNCIMA EBSAS

7.1. BROOKS PENINSULA

Biophysical description (Fig. 7): The continental shelf of Vancouver Island is at its narrowest off Brooks Peninsula, this area often has an offshore flow of nearshore waters and it is a significant north/south boundary area for many eastern Pacific species.

Note: The Brooks Peninsula EBSA has been expanded on the advice of Dave Mackas to a buffer of 55km around the peninsula and (5) has been added to that presented in Clarke and Jamieson (2006b).. Contiguous to the WCVI Brooks Peninsula proposed EBSA (Section 4.1).

Biological significance: (Uniqueness, Aggregation)

1) The area around Brooks Peninsula supports a high species diversity of breeding and migrating bird species, including Phalaropes, Common Murre, Tufted Puffin, Sooty Shearwater, Glaucous-winged Gull, Rhinoceros Auklet and Black-legged Kittiwake

(K. Morgan, CWS, Sidney, pers. comm.). There is a large seabird breeding colony at Solender Island.

2) Sea otters are abundant there, and this species is listed as threatened by COSEWIC and the IUCN. There are two areas within PNCIMA where sea otters have established (Sea Otter Recovery Team, 2002), and the proposed Brooks Peninsula EBSA includes a portion of one of these areas.

3) There are only three spawning populations of green sturgeon known in North America and all have been listed as threatened under the US Endangered Species Act. A significant number of animals tagged in the US have recently been shown to utilize the Brooks Peninsula area (Welch *et al.*, 2004). This is the only place in PNCIMA where this species has been shown to concentrate, but this may be due to limited data availability. From the acoustic tracking studies project underway by Pacific Ocean Shelf Tracking (POST), it appears that individual green sturgeon may spend approximately six weeks in this area. It is hypothesized that this area acts as a type of staging area for sturgeon travelling to or from Alaska (D. Welch, POST & DFO, Nanaimo, pers. comm.).

4) A larger lingcod spawning and rearing area overlaps the Brooks Peninsula EBSA (West Coast Offshore Exploration Panel, 1985. This area was identified as an IA for lingcod and is the only area of its kind known from PNCIMA.

5) There is an Olympia oyster aggregation in Klaskino Inlet (this is in addition to what was reported in Clarke and Jamieson 2006b)

7.2. SCOTT ISLANDS

Biophysical description (Fig. 2H): The waters surrounding the Scott Islands are an area of significant tidal mixing that drives high productivity (W. Crawford, DFO, Sidney. pers. comm.). The southern boundary has been extended from that described by Clarke and Jamieson (2006b) to include Quatsino Sound.

Biological significance: (Uniqueness, Aggregation):

1) The Scott Islands are the most important breeding grounds for sea birds in British Columbia and support the densest aggregation in the North Pacific (Rodway *et al.*, 1991). The Scott Islands have been identified as a globally significant Important Bird Area (IBA) by Birdlife International. Globally significant proportions of Cassin's Auklet, Rhinoceros Auklet, and Tufted Puffin are found there. Nationally significant populations of Common Murres, Brandt's Cormorant, Pelagic Cormorant, Pigeon Guillemot, Glaucous-winged Gull, Leach's Storm-Petrel and Fork-tailed Storm-Petrel breed on these islands (Amey *et al.*, 2004). Triangle Island hosts the largest bird breeding colony in BC. Based on this information and the occurrence of the Black-footed albatross, Northern Fulmar, Sooty Shearwater, Herring and Thayer's gulls, this area was identified as an IA (K. Morgan, CWS, Sidney, pers. comm.). Large numbers of seabirds from the Scott Islands' breeding colonies, along with seabirds from elsewhere, forage in the surrounding area (Amey *et al.*, 2004) and therefore this IA includes both the breeding colonies at its core and the adjacent wider foraging grounds.

2) The Scott Islands is an IA identified for humpback whales because it is an area of known concentration of this species.

3) A small part of the North Pacific gray whale population, referred to as summer resident gray whales, is repeatedly observed in certain northern areas outside the migration period (Calambokidis *et al.*, 2000). These whales remain in B.C. waters to feed instead

of migrating to northern feeding grounds (J. Ford, DFO, Nanaimo, pers. comm.; Heise *et al* 2003). This EBSA contains an IA identified as a feeding area for the summer resident gray whale population.

4) The largest Steller sea lion breeding rookery is found in the Scott Islands group. A large fur seal feeding IA was identified in Queen Charlotte Sound (P. Olesiuk, DFO, Nanaimo, pers. comm.) and overlaps a portion of the Scott Islands proposed EBSA.

5) One of only two areas within PNCIMA where sea otters have established (Sea Otter Recovery Team, 2002) is found within this EBSA.

6) A spawning and rearing area around Cook Bank was identified as an IA for Pacific cod (West Coast Offshore Exploration Panel, 1985).

7) A single IA was identified for spawning and rearing for lingcod and it overlaps the Scott Islands EBSA (West Coast Offshore Exploration Panel, 1985).

8) The large Queen Charlotte Sound spawning and rearing area for sablefish contains the Scott Islands EBSA (West Coast Offshore Exploration Panel, 1985).

9) A large portion of the IA identified for flatfish as a spawning and rearing area (West Coast Offshore Exploration Panel, 1985) is included in this EBSA.

10) An important feeding area for hake is located within the Scott Islands EBSA. This species is present in this area between May and September.

11) A summer feeding area important for herring is located within the bounds of the Scott Islands EBSA (D. Hay, T. Theirrault, J. Schweigert, DFO, Nanaimo, pers. comm.).

7.3. HAIDA GWAII NEARSHORE

Biophysical description (Figure 7): This area includes the intertidal and nearshore area. Close to the coast, there is tidal mixing and fronts. Tidal fronts occur at the boundary between areas of stratified waters and highly mixed waters because of tidal currents, and there can be high productivity in these regions as they can concentrate zooplankton.

Biological Significance (Uniqueness, Aggregation, Fitness Consequences):

1) Includes part of the Fin whale, *Balaenoptera physalus*, important area based on aggregations of animals documented in the BC Cetacean Sightings Network (BCCSN) and historical whaling database.

2) Part of the Gray Whale, *Eschrichtius robustus*, migration corridor overlaps with this area. They migrate north to the Bearing Sea from February to May and south from December to January.

3) Contains one of five major herring, *Clupea pallasi,* spawn areas and surrounding juvenile rearing areas in PNCIMA.

4) One of seven areas of high aggregation for Humpback whales, *Megaptera novaeangliae*, overlaps here.

5) Contains an important area for marine birds. Dense aggregations of Sooty shearwaters undergo their primary moult in the spring off the east coast of Moresby Island, and these shallow waters are thought to provide shelter from harsh weather and a refuge from predation (K. Morgan, CWS, Sidney, pers. comm.). In addition, the highest densities of phalaropes, Herring gulls and Ancient Murrelets are found over Dogfish Bank in Hecate Strait in the spring and summer (Morgan 1997).

6) Contains a relatively small part of both Pacific cod, *Gadus macrocephalus* and Sole spawning and juvenile rearing area identified by some undocumented form of Delphic exercise (West Coast Offshore Exploration Panel, 1985). Sole refers to a grouping of the following species: Arrowtooth flounder (*Atheresthes stomias*), Petrale sole (*Eopsetta jordani*), Butter sole (*Isopsetta isolepis*), Rock sole (*Lepidopsetta bilineata*), Dover sole (*Microstomus pacificus*), and English sole (*Parophrys vetulus*).

7) Part of one of the two important areas identified for the red sea cucumber, *Parastichopus californicus,* based on concentrations of productive and high density beds overlaps this area.

7.4. CENTRAL MAINLAND NEARSHORE

Biophysical description (Figure 7): The north end of Aristazabal Island is an area of tidal mixing and tidal fronts, and seems to be a region for plumes of water that spread south in the summer. The area extent of this region is difficult to define, since the processes here depend on upwelling, tidal mixing and outflow of fresh water from the coast and inflow of saltier water from Hecate Strait (B. Crawford, DFO, pers. comm.). This area was identified as an important oceanographic area (Clarke and Jamieson 2006). The original area identified by Clarke and Jamieson (2006b) has been expanded to include the intertidal and nearshore area.

Biological Significance (Uniqueness, Aggregation, Fitness Consequences):

1) Contains part of one of five areas where northern resident killer whales, *Orcinus orca,* are known to aggregate for part of the year, as well as socialize and travel.

2) Contains part of one of the six Walleye Pollock, *Theragra chalcogramma*, and one of three sablefish, *Anoplopoma fimbria*, spawning and juvenile rearing area identified by some undocumented form of Delphic exercise (West Coast Offshore Exploration Panel, 1985).

3) Contains the Danger Rocks Steller sea lion, *Eumetopias jubatus,* rookery and surrounding foraging area (one of the three rookeries on the B.C. coast). As well the three year round haul outs (out of 16) and surrounding foraging areas (Bonilla Island, Isnor Rock, Steele Rock).

4) Includes part of the Fin whale, *Balaenoptera physalus*, important area based on aggregations of animals documented in the BC Cetacean Sightings Network (BCCSN) and historical whaling database.

5) Contains an important area for marine birds. Dense aggregations of Sooty shearwaters undergo their primary moult in the spring off the east coast of Moresby Island, and these shallow waters are thought to provide shelter from harsh weather and a refuge from predation (K. Morgan, CWS, Sidney, pers. comm.). In addition, the highest densities of phalaropes, Herring gulls and Ancient Murrelets are found over Dogfish Bank in Hecate Strait in the spring and summer (Morgan 1997).

7.5. BELLA BELLA NEARSHORE

Biophysical description (Fig. 7): This area includes the intertidal and nearshore area. Close to the coast, there is tidal mixing and fronts. Tidal fronts occur at the boundary between areas of stratified waters and highly mixed waters because of tidal currents, and there can be high productivity in these regions as they can concentrate zooplankton.

Biological Significance (Uniqueness, Aggregation, Fitness Consequences):

1) This area includes one of the two areas within PNCIMA where sea otters, *Enhydra lutris,* have established (Sea Otter Recovery Team, 2002). The sea otter was re-examined and designated as Special Concern by COSEWIC in 2007.

2) Geoduck clams, *Panopea abrupta,* are widely distributed throughout PNCIMA. This area overlaps the only important area identified in PNCIMA based on aggregations of high geoduck productivity and/or density beds.

3) One of the two important areas identified for the red sea cucumber, *Parastichopus californicus,* based on concentrations of productive and high density beds overlaps this area.

4) Manila clam, *Venerupis phillipinarum*, was introduced to B.C. in the 1930s and now supports a commercial fishery. This area includes the important identified with concentrations of productive beds.

5) Overlaps one of the five herring, *Clupea pallasi*, spawning and rearing important areas.

6) Part of the Queens Sounds/Calvert Island shrimp important area overlaps with this region. This area supports aggregations of sidestripe shrimp, spiny pink shrimp and smooth pink shrimp.

7) The Gosling Rocks Steller sea lion, *Eumetopias jubatus,* haulout and surrounding foraging area (one of 16 year round haul outs identified as important areas) overlaps here.

8) Part of the area identified for northern resident killer whales, *Orcinus orca,* socialization and traveling for passes through this area.

8. DISCUSSION

As noted by Clarke and Jamieson (2006b), the PNCIMA ecoregion is considerably smaller than Atlantic Canada LOMAs, and the WCVI and SoG ecoregions represent an even smaller portion of Atlantic ecoregions. Since the biological characteristics (home ranges, habitat depths, etc.) for of each region's species are basically similar, this means that species' IAs and even EBSAs, regardless of the ecoregion they are in, may be similar in scale, with the result being that a greater percentage of the area of smaller ecoregions can be expected to be defined as EBSAs.

In PNCIMA and on the WCVI, outer coast physical oceanographic features were used as the boundaries for designating some of the final proposed EBSAs. The oceanographic features were identified based on characteristics that fit the EBSA criteria including: uniqueness both regionally and nationally and characteristics that concentrate productivity (Aggregation criteria).

It was a challenge to classify oceanographic features in the SoG based on the above criteria due to the smaller scale of the region and because most of the Strait is productive during the spring (D. Masson, DFO, Sidney, pers. comm.), making it difficult to identify areas that are particularly productive under the aggregation criteria. During the summer and fall, thermal stratification also occurs over much of the Strait,

The regional ESSIM workshop on significant areas suggested < 40% of the total area be assigned EBSA status (DFO 2006a). Both the WCVI and SOG have a relatively small total size and a complex geography and ecology relative to the other national IM areas and therefore we consider being on the higher side of the desired EBSA area proportion is both realistic and justifiable.

Table 14. Comparison of overlap between the oceanographic features and bottleneck areas that are proposed EBSAs and the biological IAs identified in Phase 1 (Levesque and Jamieson 2011) of the WCVI and SoG EBSA identification process. The IAs column indicates the total number of important areas identified for that species or species group in that ecoregion, the 'Overlap' column indicates the number of IAs that overlap with the EBSAs and % shows the percentage of the IAs area that is captured by EBSAs.

***Note:** the number of IAs in the WCVI and SoG added together do not add up to the total number of IAs because some IA spanned both the WCVI and SoG and thus were split into two for separate WCVI and SoG analyses.*

Biological Layer	WCVI IAs	Overlap	%	SoG IAs	Overlap	%
Leatherback Turtle	1	1	64	0	n/a	n/a
Marine Mammals						
Harbour Porpoise	4	3	84	4	4	81
Killer Whale – Northern Residents	0	n/a	n/a	0	n/a	n/a
Killer Whale - Southern Residents	1	1	99	1	1	93
Sperm Whale	1	1	49	0	n/a	n/a
Humpback Whale	2	2	80	0	n/a	n/a
Gray Whale (resident and migratory)	9	6	48	0	n/a	n/a
Blue Whale	1	1	49	0	n/a	n/a
Sei Whale	1	1	49	0	n/a	n/a
Fin Whale	1	1	49	0	n/a	n/a
Sea Otter	1	1	16	0	n/a	n/a
Harbour Seal	27	21	67	23	17	45
Steller Sea Lion	11	5	72	1	1	10
Fur Seal	1	1	100	0	n/a	n/a
Pelagic fish						
Herring	7	7	74	4	4	36
Hake	3	3	90	3	2	6.3
Pacific Sardine	1	1	75	0	n/a	n/a
Sand Lance	3	3	100	2	2	100
Anadromous fish						
Eulachon	4	4	77	6	3	50
Salmon	1	1	77	3	3	48
Green Sturgeon	1	1	57	0	n/a	n/a
Groundfish (flatfish and roundfish)						
Rockfish	0	n/a	n/a	0	n/a	n/a
Lingcod	0	n/a	n/a	0	n/a	n/a
Walleye Pollock	0	n/a	n/a	1	1	41
Pacific cod	1	1	95	1	0	0
Sablefish	0	n/a	n/a	0	n/a	n/a
Sole	n/a	n/a	n/a	n/a	n/a	n/a
Arrowtooth Flounder	1	1	100	0	n/a	n/a
Curlfin Sole	1	1	67	0	n/a	n/a

Biological Layer	WCVI IAs	Overlap	%	SoG IAs	Overlap	%
Deepsea Sole	1	1	100	0	n/a	n/a
Dover Sole	4	4	98	0	n/a	n/a
English Sole	5	5	82	0	n/a	n/a
Flathead Sole	1	1	100	0	n/a	n/a
Sanddab	1	1	100	0	n/a	n/a
Petrale Sole	7	7	93	0	n/a	n/a
Rex Sole	2	2	97	0	n/a	n/a
Rock Sole	2	2	83	0	n/a	n/a
Sand Sole	2	2	100	0	n/a	n/a
Pacfic Halibut	2	2	99	0	n/a	n/a
Juvenile Flatfish	1	1	32	0	n/a	n/a
Elasmobranchs						
Spiny Dogfish	0	0		2	1	2.9
Basking Shark	1	1	61	0	n/a	n/a
Sixgilled Shark	5	1	18	1	1	16
Brown Cat Shark	1	1	78	1	1	1.3
Pacific Sleeper Shark	2	2	100	0	n/a	n/a
Deepsea or Abyssal Skate	1	1	56	0	n/a	n/a
Sandpaper Skate	1	1	81	1	1	81
Roughtail Skate	1	1	67	0	n/a	n/a
Alaska Skate	1	1	99	1	1	85
Longnose Skate	1	1	90	1	1	25
Big Skate	1	1	91	1	1	25
Invertebrates						
Euphausiids	0	0		1	1	0
Geoduck	1	0	0	0	n/a	n/a
Red Sea Cucumber	0	n/a	n/a	0	n/a	n/a
Scallops (four species)	0	0		4	3	51
Green Sea Urchin	1	1	99	2	2	78
Bivalves (includes Manila Clam, Butter Clam, Olympia Oyster and Pacific Oyster)	9	3	45	4	2	24
Manila Clam	0	n/a	n/a	1	0	0
Olympia Oyster	7	1		0	n/a	n/a
Razor Clam	1	0	0	n/a	0	n/a
Dungeness Crab	2	2	86	3	3	67
Tanner Crab	1	1	40	1	1	86
Possible Cloud Sponge areas	0	n/a	n/a	0	n/a	n/a
Coral and Sponge Bycatch	3	3	94	0	n/a	n/a
Sponge reefs	0	0		16	8	11
Shrimp	6	6	86	10	6	20
Marine Birds	6	4	86	3	3	53
Totals:	156	127	74	101	74	40

Table 15. Number of Important Areas overlapping in each EBSA.

EBSA	No. of IAs
WCVI	
1) Brooks Peninsula Jets	29
2) Shelf Break	33
3) Continental Shelf off Barkley Sound	27
4) Juan de Fuca Eddy	29
5) Bottleneck: Barkley Sound and Alberni Inlet	20
6) Bottleneck: Juan de Fuca Strait	14
SOG	
1) Discovery Passage Entrance,	5
2) Desolation Sound and Pendrell Sound	6
3) Baynes Sound	5
4) Sabine Channel	3
5) Southern Gulf Islands	17
6) Fraser River Estuary and Boundary Bay	14
7) Glass Sponge Reefs	16
PNCIMA	
Queen Charlotte Nearshore	8
Central Mainland Nearshore	8
Bella Bella Nearshore	8

9. REFERENCES

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10.FIGURES

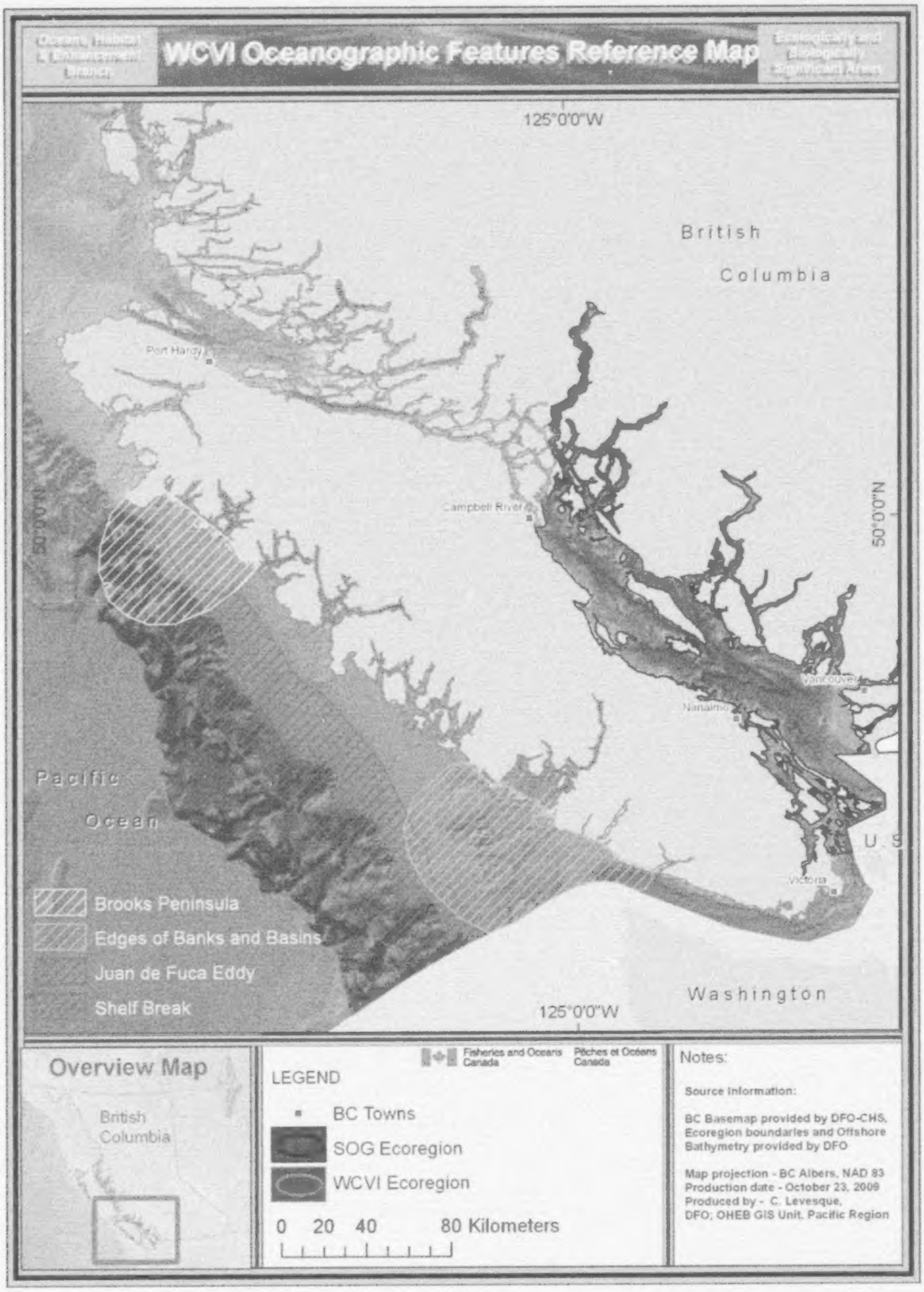

Figure 1. WCVI Oceanographic Features Reference Map.

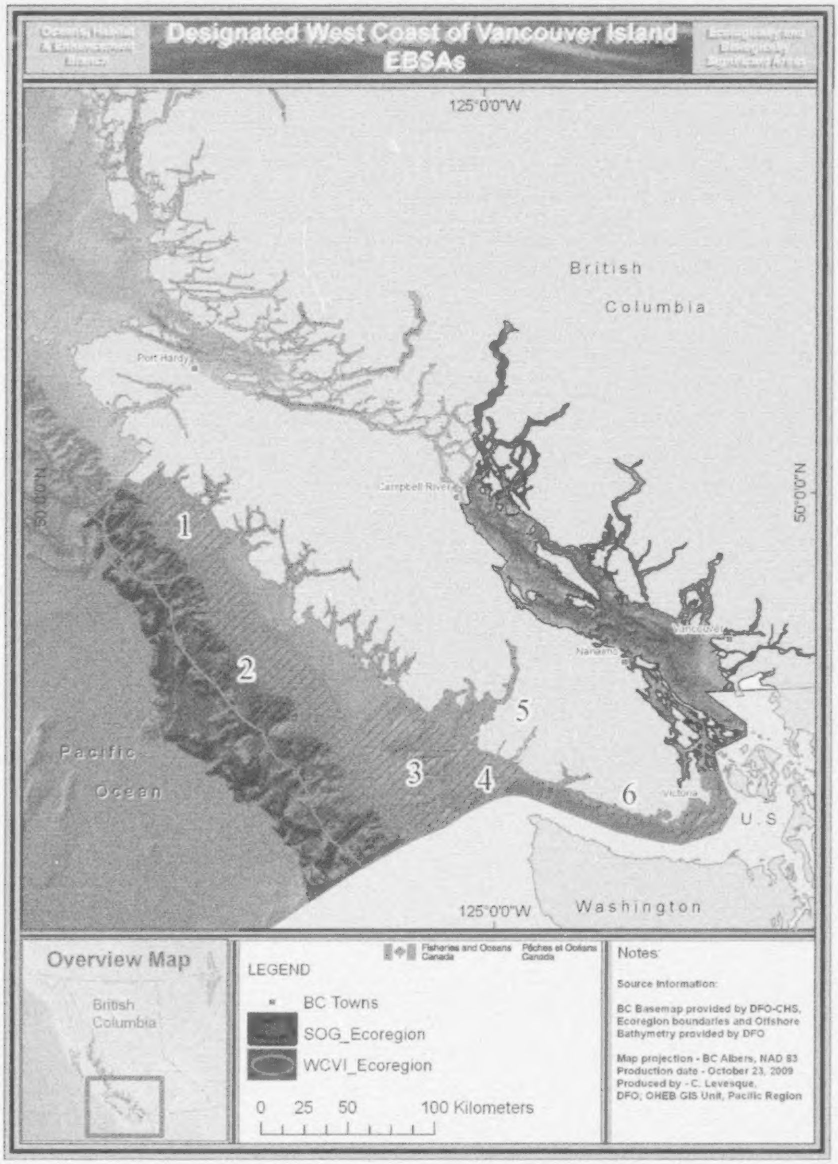

Figure 2. All EBSAs for the WCVI, excluding River Mouths and Estuaries: 1) Brooks Peninsula Jets, 2) Shelf Break, 3) Continental Shelf off Barkley Sound, 4) Juan de Fuca Eddy, 5) Bottleneck: Barkley Sound and Alberni Inlet, and 6) Bottleneck: Juan de Fuca Strait.

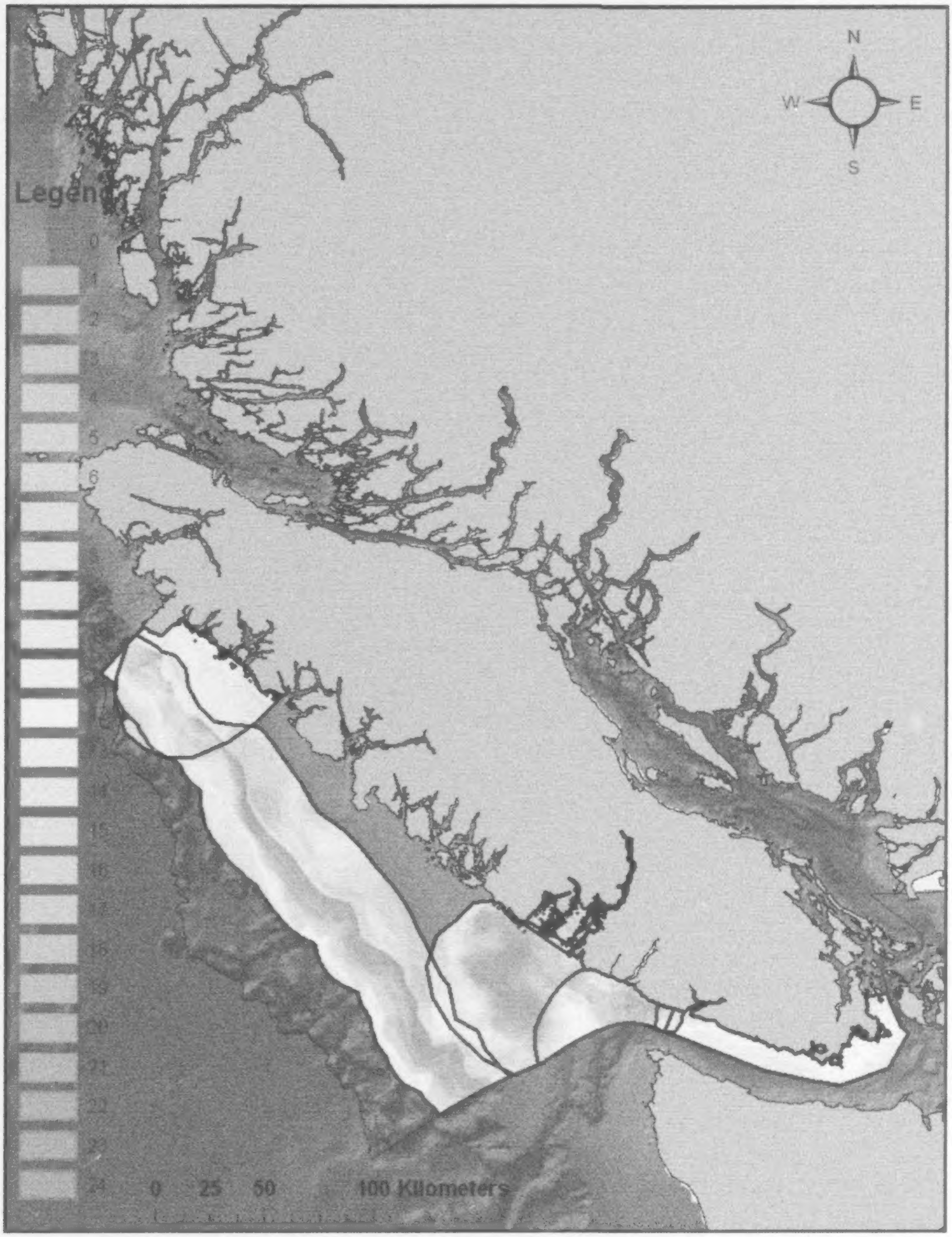

Figure 3. Counts of overlaid species IAs, i.e., the number of IA polygons overlapping, in the WCVI EBSAs.

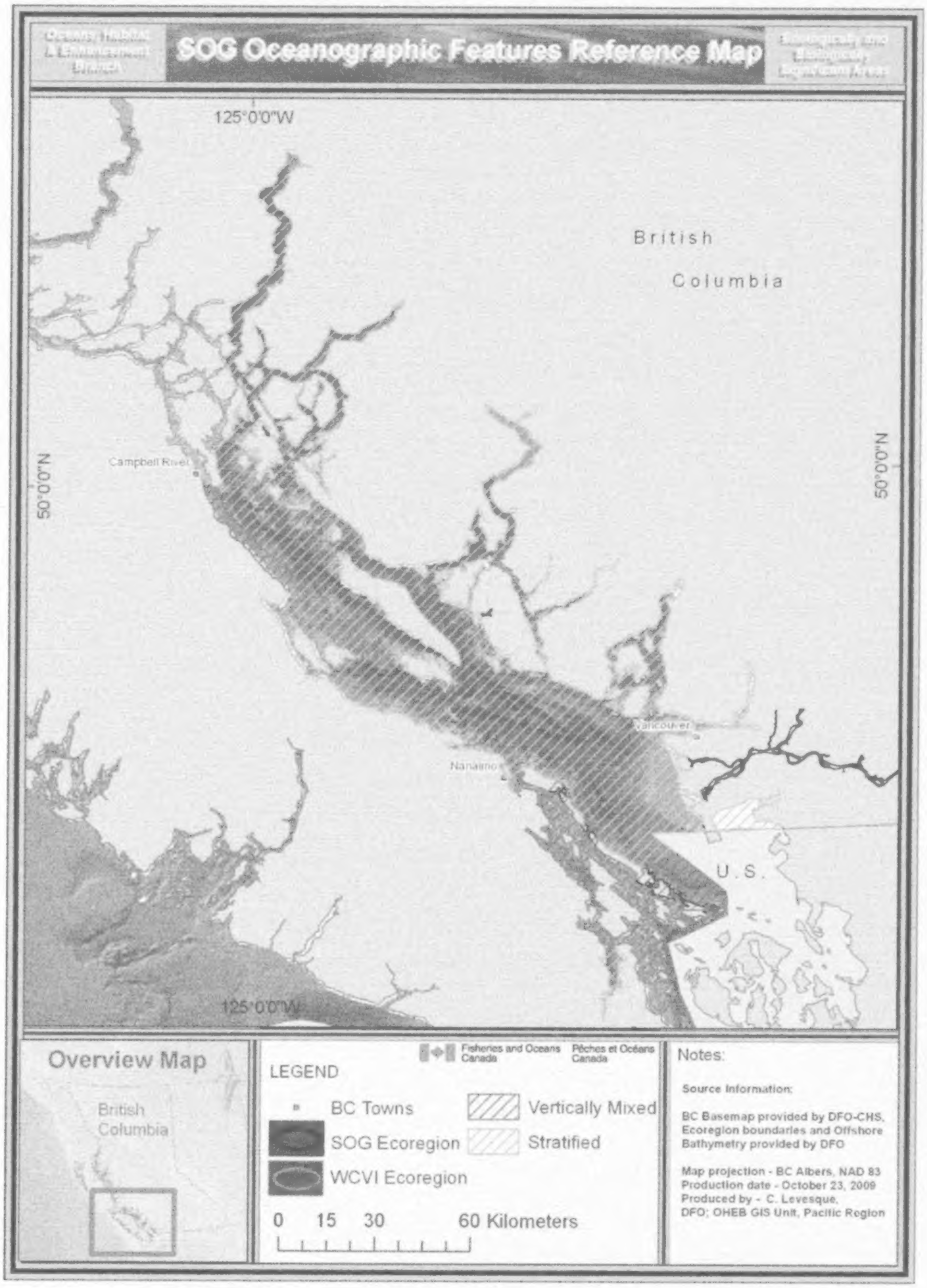

Figure 4. Strait of Georgia Oceanographic Features Reference Map.

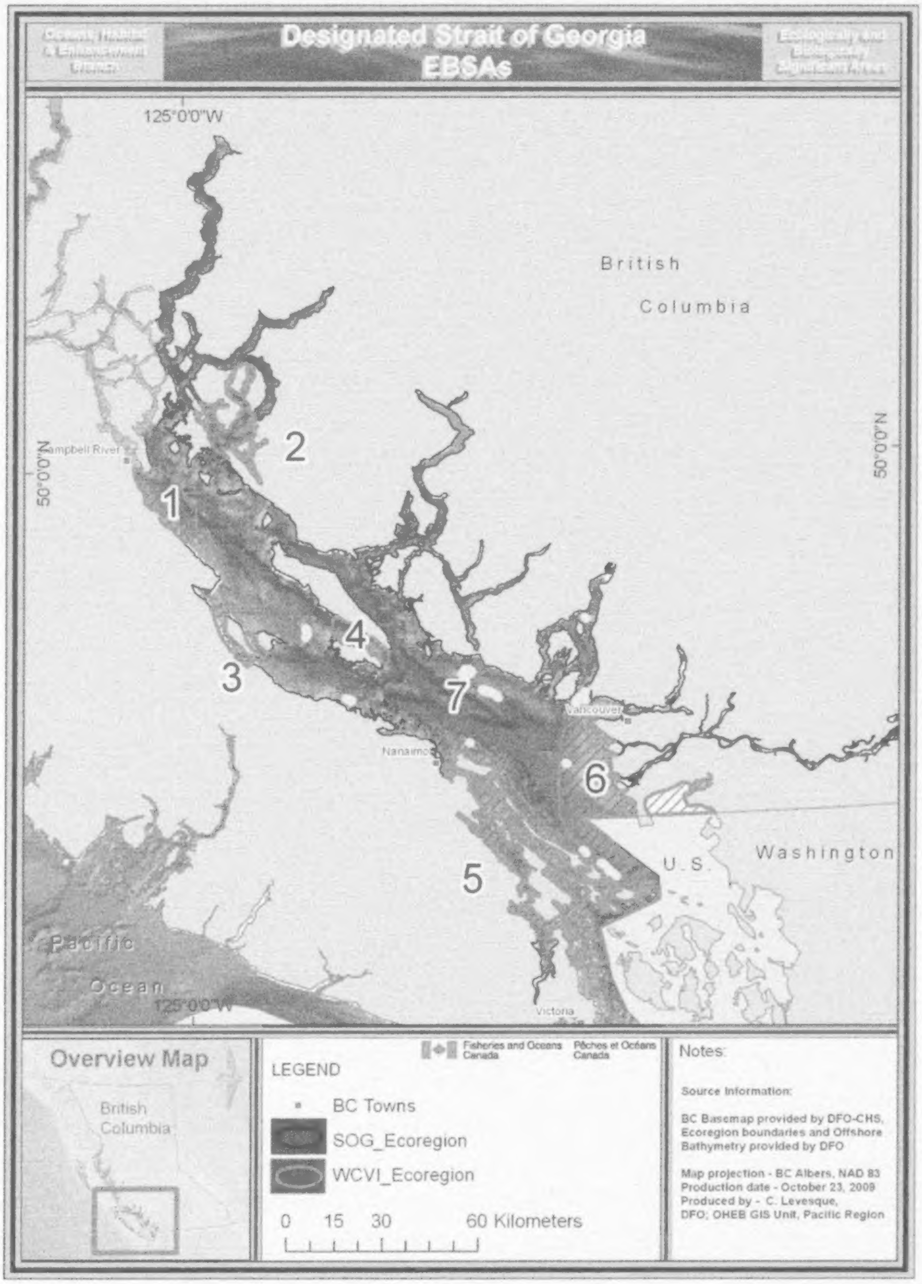

Figure 5. All EBSAs for the SoG, excluding River Mouths and Estuaries: 1) Discovery Passage Entrance, 2) Desolation and Pendrell Sounds, 3) Baynes Sound, 4)Sabine Channel, 5) Southern Gulf Islands, 6) Fraser River Estuary and Boundary Bay 7) Glass Sponge Reefs (yellow).

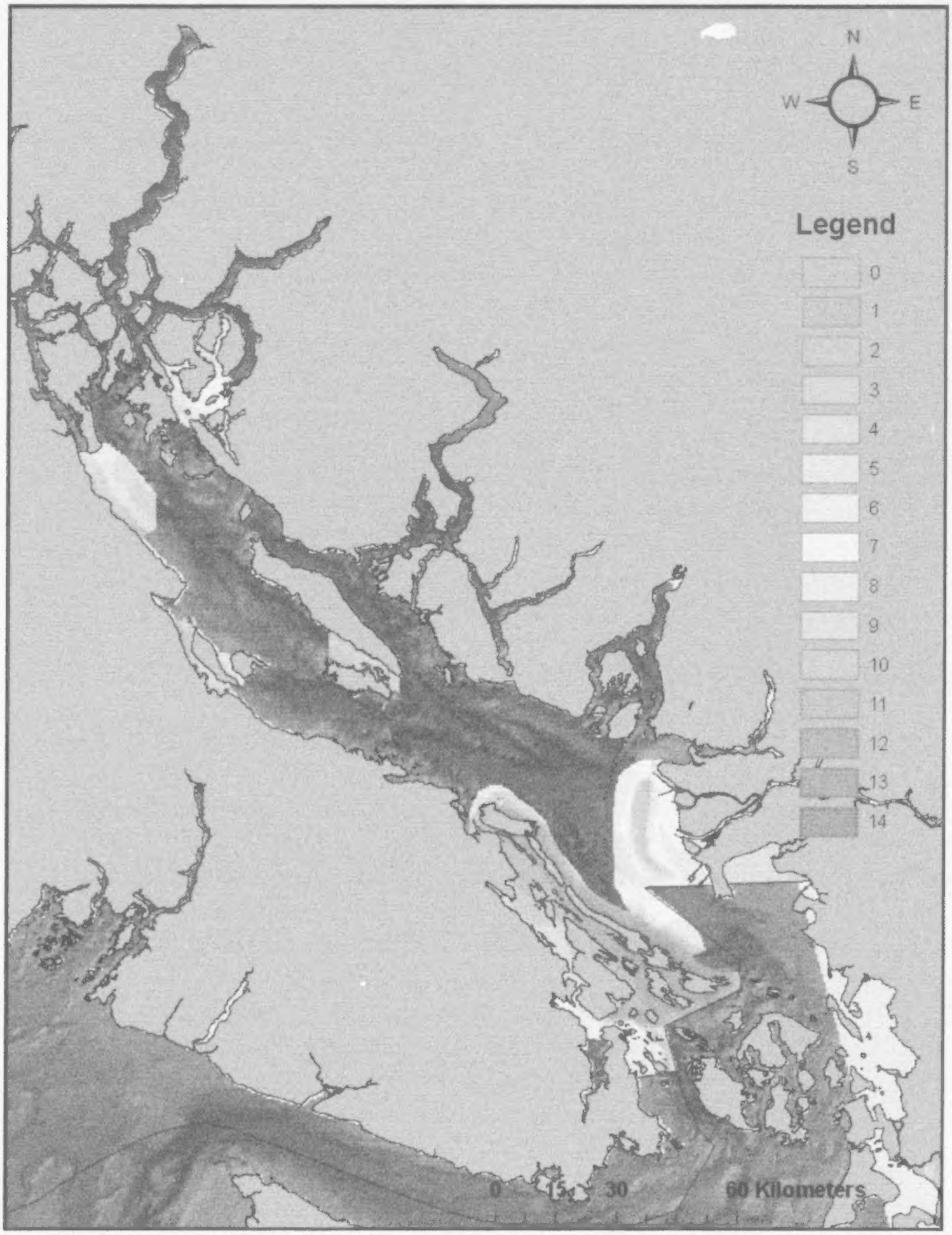

Figure 6. Counts of overlaid species IAs, i.e., the number of IA polygons overlapping, in the SoG EBSAs.

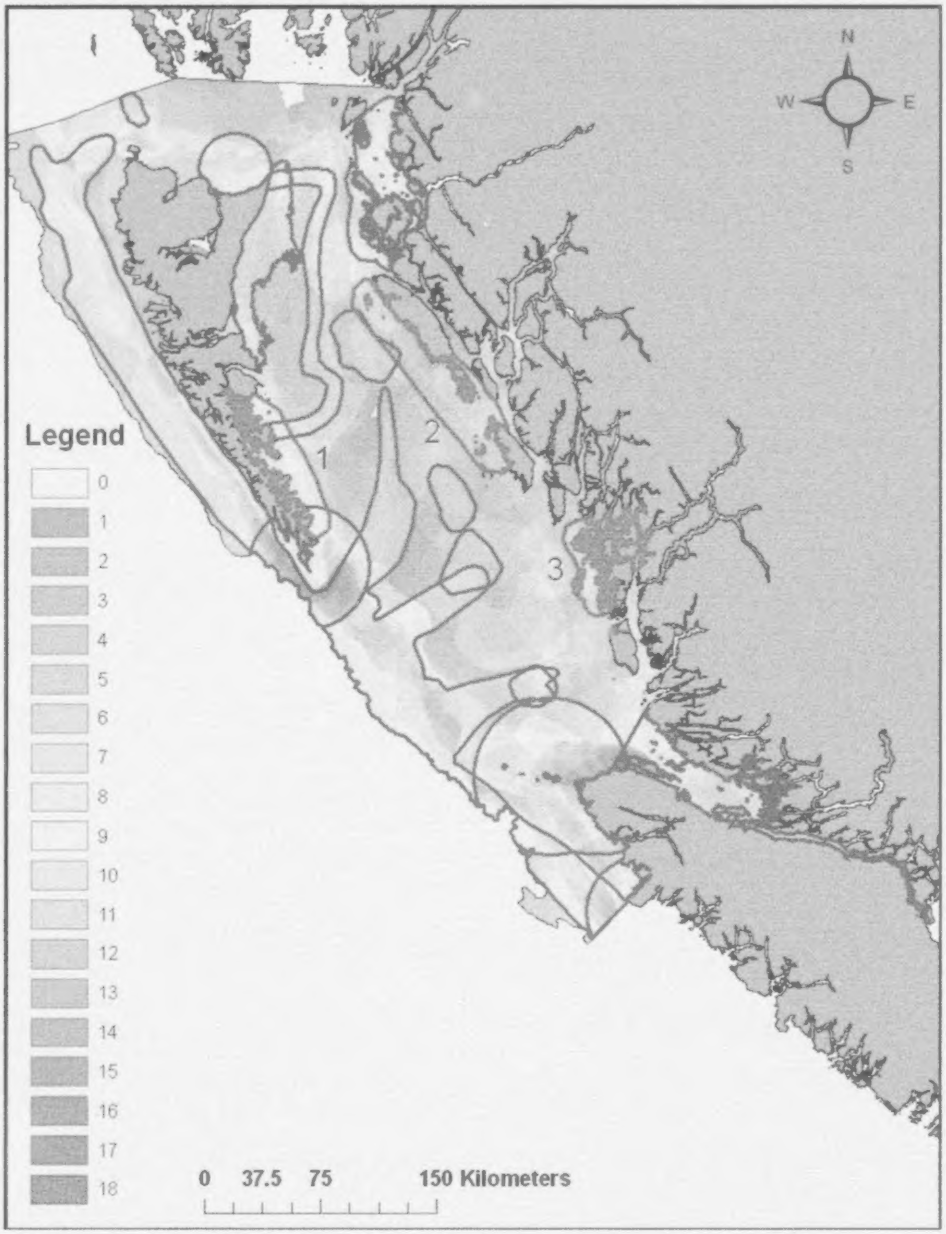

Figure 7. PNCIMA Nearshore EBSAS shown in red, with boundaries of other EBSAs listed by Clarke and Jamieson (2006b) shown in blue. 1 = Queen Charlotte Nearshore. 2 = Central Mainland Nearshore and 3 = Bella Bella Nearshore. Counts of overlaid species IAs, i.e., the number of IA polygons overlapping, in PNCIMA EBSAs is shown by the colours. Note also that the IA overlapping colours are different here from those in Clarke and Jamieson (2006b), which were incorrect because portions of the same IA included within an EBSA were inadvertently all counted as separate IAs.